# TECHNICAL ABSTRACT

# Analysis of Solar Insolation Over Karachi (Pakistan)

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From the knowledge of extraterrestrial insolation $\bar{H}_o$, day length $\bar{N}_d$ and bright sunshine hours $\bar{n}$, insolation-sunshine relation $\bar{H}/\bar{H}_o = a + b\,\bar{n}/\bar{N}_d$ is established for the prediction of monthly average daily global insolation H over Karachi. The coefficients a and b of the relation are evaluated by the least squares method and are listed in Table 1. The table also shows that the estimated values of $\bar{H}$ agree fairly well with the measured data. The relation thus can be applied for the estimates of $\bar{H}$, to the coastal localities, Jiwani and Pasni, where sunshine hours are recorded regularly.

For the prediction of daily diffuse insolation $\bar{H}_d$ among the different correlations considered, Modi & Sukhatme's relation $\bar{H}_d/\bar{H} = 1.4112 + 1.6956\,\bar{H}/\bar{H}_o$ [1] is found more appropriate for this region. The estimated diffuse insolation by this relation is also given in the Table 1.

The available global insolation over Karachi is encouraging from the point of view of application. The insolation remains around 20 MJ/m² per day throughout the year. The diffuse insolation is the least, 25% of the total, during winter (clear sky) while in summer it increases to about 50% due to an overcast sky.

Table 1. Solar insolation over Karachi - the data.

| Item | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\bar{H}_o$ Estimated | 24.30 | 28.52 | 33.95 | 37.62 | 39.77 | 40.43 | 39.97 | 38.25 | 35.11 | 30.22 | 25.47 | 22.98 |
| $\bar{n}$ Measured | 8.59 | 8.92 | 8.86 | 9.48 | 9.86 | 8.16 | 5.01 | 4.94 | 7.47 | 9.28 | 9.10 | 8.66 |
| $\bar{N}_d$ Estimated | 10.64 | 11.18 | 11.88 | 12.61 | 13.21 | 13.52 | 13.39 | 12.88 | 12.19 | 11.46 | 10.82 | 10.48 |
| $\bar{H}$ Measured | 15.83 | 18.00 | 21.05 | 22.48 | 23.44 | 22.75 | 19.16 | 17.85 | 18.94 | 19.36 | 16.42 | 14.88 |
| $\bar{H}$ Estimated | 15.94 | 17.25 | 20.97 | 23.02 | 23.51 | 22.44 | 19.81 | 17.56 | 19.35 | 18.94 | 16.71 | 15.05 |
| % Difference | -0.4 | 2.6 | 0.4 | -2.4 | -0.3 | 1.4 | -3.3 | 1.6 | -2.2 | 2.2 | -1.8 | -1.1 |
| Coefficient, a | 0.047 | 0.053 | 0.200 | 0.193 | 0.031 | 0.109 | 0.157 | 0.112 | 0.052 | 0.088 | 0.055 | 0.082 |
| Coefficient, b | 0.754 | 0.704 | 0.565 | 0.565 | 0.747 | 0.740 | 0.906 | 0.914 | 0.819 | 0.665 | 0.715 | 0.693 |
| Correlation coefficient, r | 0.85 | 0.79 | 0.66 | 0.82 | 0.59 | 0.85 | 0.87 | 0.89 | 0.93 | 0.57 | 0.76 | 0.65 |
| $\bar{H}_d$ Estimated | 4.90 | 6.15 | 7.30 | 8.92 | 9.64 | 10.39 | 11.46 | 11.06 | 9.31 | 6.30 | 5.24 | 4.67 |

## REFERENCE

1. Modi, V. and S.P. Sukhatme (1979), Estimation of daily total and diffuse insolation in India from weather data, *Solar Energy*, Vol. 22, No. 5, pp. 407-411.